
Citation:

Whitehead, S and Till, K and Weaving, D and Jones, B (2018) Authors' Reply to Carling et al: Comment on: "The Use of Microtechnology to Quantify the Peak Match Demands of the Football Codes: A Systematic Review". Sports Medicine. ISSN 0112-1642 DOI: <https://doi.org/10.1007/s40279-018-1028-8>

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Authors Reply to Carling et al. Comment on: “The Use of Microtechnology to Quantify the Peak Match Demands of the Football Codes: A Systematic Review.”

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Dear Editor,

We would like to thank Carling et al. [1] for their constructive comments on our recent systematic review [2] and welcome the opportunity to address the points they raise. We agree that further debate and research is required in this area. We addressed a range of limitations to current research and suggested a range of future directions in our review [2], and we are glad that this has prompted further discussions in the area.

Firstly, Carling and colleagues [1] expressed their concerns that the restriction of the review [2] to microtechnology derived data omitted several studies in soccer (e.g., [3-7]). These studies were not included in our systematic review due to their use of optical tracking techniques as opposed to microtechnology devices, thus they did not meet the eligibility criteria of the review and were removed at the screening stage (see Figure 1 in [2]). We would firstly like to emphasis the title of our review: “The use of *microtechnology* to quantify...”, indicating the purpose of the review was to provide awareness of how microtechnology devices can be used in research and practice to quantify the peak demands of the football codes. This is further demonstrated by the primary aims of the review, which were “to: (1) determine the methodologies utilised to quantify the peak match demands within the football codes; (2) identify the GPS and MEMs variables reported for peak match demands”. The advancement in microtechnology units has led to increased popularity in their use amongst the football codes, particularly in the use of the micro-electrical mechanical systems (MEMs) derived variables, e.g., PlayerLoad™ (as used by two soccer studies included in the review [8,9]), which cannot be derived from optical tracking techniques.

The rationale for the exclusion of studies using optical tracking techniques was due to the low agreement between optical tracking and GPS technologies. Semi-automatic multiple-camera systems are reported to measure higher total distances covered, particularly at higher running speeds [10,11] (~24 to 37% greater compared to GPS technologies [11]), and significantly greater peak 5-minute periods of high intensity running (~247 vs 188 m for semi-automatic multiple-camera systems vs GPS devices respectively) [11], thus limiting the ability to integrate data between systems without calibration equations [10]. Therefore, it is likely that separate summaries would have been required to report both optical tracking and

microtechnology data within the same systematic review for each of the investigated variables. Whilst this could be achieved if the review was soccer specific, we feel that this would have diluted the data and conclusions within the systematic review when considering all the football codes. Furthermore, soccer is one of the few football codes that use optical tracking techniques, thus was not deemed an important focus when the review was targeted at all the football codes.

Secondly, the application and use of the peak demands or ‘worst case scenario’ of match-play in practice was questioned [1]. Although Carling and colleagues [1] propose some interesting points for discussion within the area, unfortunately we were unable to include information on the questions posed as this research has not yet been undertaken. We state in the discussion section that further information is required, such as additional concurrent physical (e.g., collisions in the rugby codes) and technical-tactical demands (e.g., during what passages/type of play are these demands occurring) to aid prescribing more code-specific drills. Additionally, the ability to provide more specific prescription recommendations in our systematic review is limited by the current lack of research on the dose-response of fatigue and training adaptations to peak demands specific training. Carling et al [1] also highlight the match-to-match variability of the peak high speed running activity in soccer [12], questioning the impact on prescription of training. We do acknowledge that variability does naturally exist and should be considered. By utilising the ranges in the peak demands often reported [13,14], players can be prepared for the highest peak demands that may be experienced during the season.

Further interesting points are raised by Carling et al [1] regarding the alignment of the peak demands with the technical-tactical demands, which we provided as a future research direction based upon timestamping microtechnology and video analysis data. Whilst we acknowledge that some areas of our review could have been expanded further we were constrained by the journal word count and tried to summarise areas for future research. The papers identified by Carling and colleagues (e.g., 15-18) provide further insight into understanding the physical and technical-tactical demands and we would like to thank Carling and colleagues for referring readers to these journals for developing a greater understanding in this area.

Finally, we acknowledge the points made by Carling et al [1] regarding the use of multiple clubs. Whilst their rationale for why multiple club studies cannot be easily generalised is valid, it is anecdotal, and is dependent upon the research question, but again providing scope for further research. Furthermore, with appropriate statistical analysis some of the factors mentioned (e.g., physical and technical abilities) could be accounted for. Therefore, we still believe researchers should aim to collect multi-club data sets to enhance knowledge and understanding of match-play of sports and wider factors linked to performance.

We would again like to thank Carling et al [1] for their letter, as we feel that it poses interesting future original research questions. The exclusion of their work, was due to the specific purpose of our systematic review, which was clearly outlined and defined within our search criteria.

Compliance with Ethical Standards

Funding

No sources of funding were used to assist in the preparation of this letter.

Conflict of Interest

Sarah Whitehead, Kevin Till, Dan Weaving and Ben Jones declare they have no conflicts of interest relevant to the content of this letter.

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